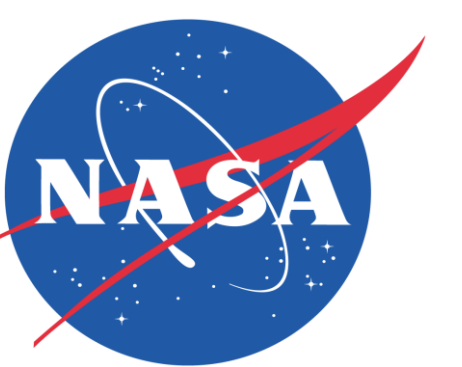




An Update on the Hydrological Land Surface Data and Services at NASA GES DISC



AMS January 2023

NASA/Goddard EARTH SCIENCES DATA and INFORMATION SERVICES CENTER (GES DISC)

Hydrological land surface data is open access, including forcing variables, land surface states, stores and flux fields from land surface models. The hydrological land surface data are also cloud-enabled accessible via direct S3 access (AWS us-west-2).

Introduction

The NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) is one of twelve NASA Earth Observing System data centers that document, process, archive and distribute data from Earth science missions and related projects. The GES DISC hosts many hydrological land surface data products and provides reliable and robust data access and services to users worldwide. This presentation, focusing on hydrological land surface data, provides a summary table of the hydrological data holdings and a list of variables from the forcing and model outputs, along with discussions of recent updates to data and data services.

Variables

Type	Variable	Unit
Meteorological Forcing	Wind speed	m
	Total precipitation rate	kg/m ² /s
	Near surface air temperature	K
	Near specific humidity	kg/kg
	Surface pressure	Pa
	Downward short-wave radiation	W/m ²
	Downward long-wave radiation	W/m ²
Land Surface Model (LSM) Output	Net short-wave radiation flux	W/m ²
	Net long-wave radiation flux	W/m ²
	Latent heat flux	W/m ²
	Sensible heat flux	W/m ²
	Ground heat flux	W/m ²
	Rain rate	kg/m ² /s
	Snow rate	kg/m ² /s
	Evaporation	kg/m ² /s
	Transpiration	kg/m ² /s
	Evapotranspiration	kg/m ² /s
	Surface runoff	kg/m ² /s
	Baseflow runoff	kg/m ² /s
	Snow melt	kg/m ² /s
	Surface temperature	K
State	Albedo	~
	Snow depth water equivalent	kg/m ²
	Soil moisture	kg/m ²
	Soil temperature	K
Others	Stream flow	m ³ /s
	Flooded Fraction	~
	Flooded Area	m ²
	Irrigated water rate	kg/m ² /s
	Terrestrial water storage	mm
	Ground water storage	mm

Earthdata Login system

Access to GES DISC data **requires** an **Earthdata account**. Data continue to be free of charge. Registration is free and easy:



<https://disc.gsfc.nasa.gov/data-access>

Hydrological Land Surface Data Products

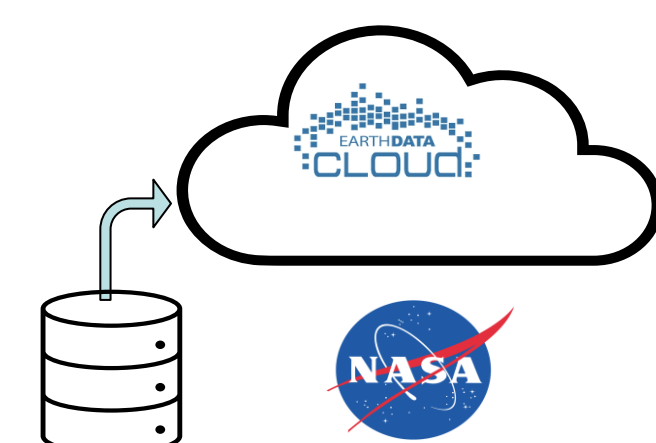
	Land Surface Model	Temporal										Spatial							
		Coverage				Resolution					Coverage				Resolution				
				Latency in Days	Climatology	Anomaly	1-hour	3-hour	1 day	7 days	1 month	North America	Global Land	Africa	Asia	0.1 degree	0.125 degree	0.25 degree	1.0 degree
NLDAS-2*	Forcing A	1979-01-01 ~ present	~4	X	X	X				X	X						X		
	Forcing B	1979-01-01 ~ present	~4	X		X				X	X						X		
	Noah	1979-01-02 ~ present	~4	X	X	X				X	X						X		
	Mosaic	1979-01-02~ present	~4	X		X				X	X						X		
	VIC	1979-01-02 ~ present	~4	X		X				X	X						X		
GLDAS-2.0	Noah	1948-01-01 - 2014-12-31					X			X		X						X	X
	Catchment	1948-01-01 - 2014-12-31						X				X						X	
	VIC	1948-01-01 - 2014-12-31					X					X							X
GLDAS-2.1*	Noah	2000-01-01 ~ present	~45				X			X		X						X	X
	Catchment	2000-01-01 ~ present	~45				X			X		X							X
	VIC	2000-01-01 ~ present	~45				X			X		X							X
FLDAS-1*	Noah	1982-01-01 ~ present	~1		X			X		X		X		X	X				
GRACEDADM*	Catchment	2003-02-03 ~ present	~45						X			X						X	
		2002-04-01 ~ present	~45						X		X						X		
NCALDAS-2.0	Noah	1979-01-02 - 2016-12-31																	X
SMERGE-2.0	Noah	1979-01-02 - 2019-05-10						X			X						X		
LPRM	AMSR2*	2012-07-03 ~ present	~1					X				X			X				
	AMSRE*	2002-06-19 - 2011-10-03						X				X						X	
	TMI	1997-12-07 - 2015-04-08						X				X						X	
	WINDSAT	2003-02-01 - 2012-08-01						X				X						X	

This table highlights the hydrological land surface data products available at the NASA GES DISC.

*Cloud enabled with direct S3 access.

New and Reprocessed Products	
GRACEDADM_CLSM0125US_7D.4.0	GRACEDADM_CLSM025GL_7D.3.0
GRACE-DA-DM United States (U.S.) v4.0 data are from the Catchment-LSM (CLSM) Fortuna v2.5 grid-to-grid basis simulation using the latest gridded GRACE RL06 and GRACE Follow-On Mascon v2 at 0.25 degree resolution from the University of Texas at Austin. The simulation upgrades include fixes in the DA and CLSM soil parameters using the assimilated RL06 GRACE and GRACE-FO data.	This new GRACE-DA-DM Global (GL) v3.0 data are similar to the GRACE-DA-DM U.S. v4.0 product based on the CLSM Fortuna v2.5 simulation and assimilated GRACE and GRACE-FO data from the University of Texas at Austin. This simulation is global and has a 0.25 x 0.25 degree spatial resolution.
FLDAS_NOAH01_CP_GL_M.001	FLDAS_NOAH001_G_CA_D.001
This new 0.1 x 0.1 degree monthly global data product is from the Famine Early Warning Systems Network (FEWS NET) Land Data Assimilation System (FLDAS) v001, simulated by the Noah v3.6.1 LSM forced by the combination of Global Data Assimilation System (GDAS) and Climate Hazards Groups InfraRed Precipitation with Station Preliminary (CHIRPS-PRELIM).	This new 0.01 x 0.01 degree Central Asia Daily data product is from the Famine Early Warning Systems Network (FEWS NET) Land Data Assimilation System (FLDAS) v001, simulated by the Noah v3.6.1 LSM forced by the the of Global Data Assimilation System (GDAS).
NLDAS-2 Forcing A, Forcing B, Noah, Mosaic, VIC	
The North American Land Data Assimilation System (NLDAS) data products are now archived and distributed in netCDF format. The data are converted from the corresponding GRIB files with now changes except for a reversal in sign in the Mosaic output of canopy water evaporation, transpiration, direct evaporation from bar soil and sublimation (evaporation from snow). A new variable, streamflow, has been added to the Mosaic, Noah, and VIC Land Surface Model (LSM) datasets. The monthly climatology datasets are a 40-year (1981-2022) climatology.	

GES DISC Data in the Cloud



Migrating to the Cloud

NASA is currently in the process of migrating its data products and services to the cloud. The hydrological land surface datasets are cloud-enabled. More information can be found here:

<https://disc.gsfc.nasa.gov/information/documents?title=Migrating%20to%20the%20Cloud>

Direct S3 Access

Amazon's Simple Storage Service (S3) is an object storage service that offers scalability, data availability, security and performance. GES DISC data is in the **AWS us-west-2** region and can only be accessed if users are in that same region.

Sample GES DISC URL for S3 access:

s3://gesdisc-cumulus-prod-protected/NLDAS/NLDAS_NOAH0125_H.2.0/
s3://gesdisc-cumulus-prod-protected/FLDAS/FLDAS_NOAH01_C_GL_M.001/

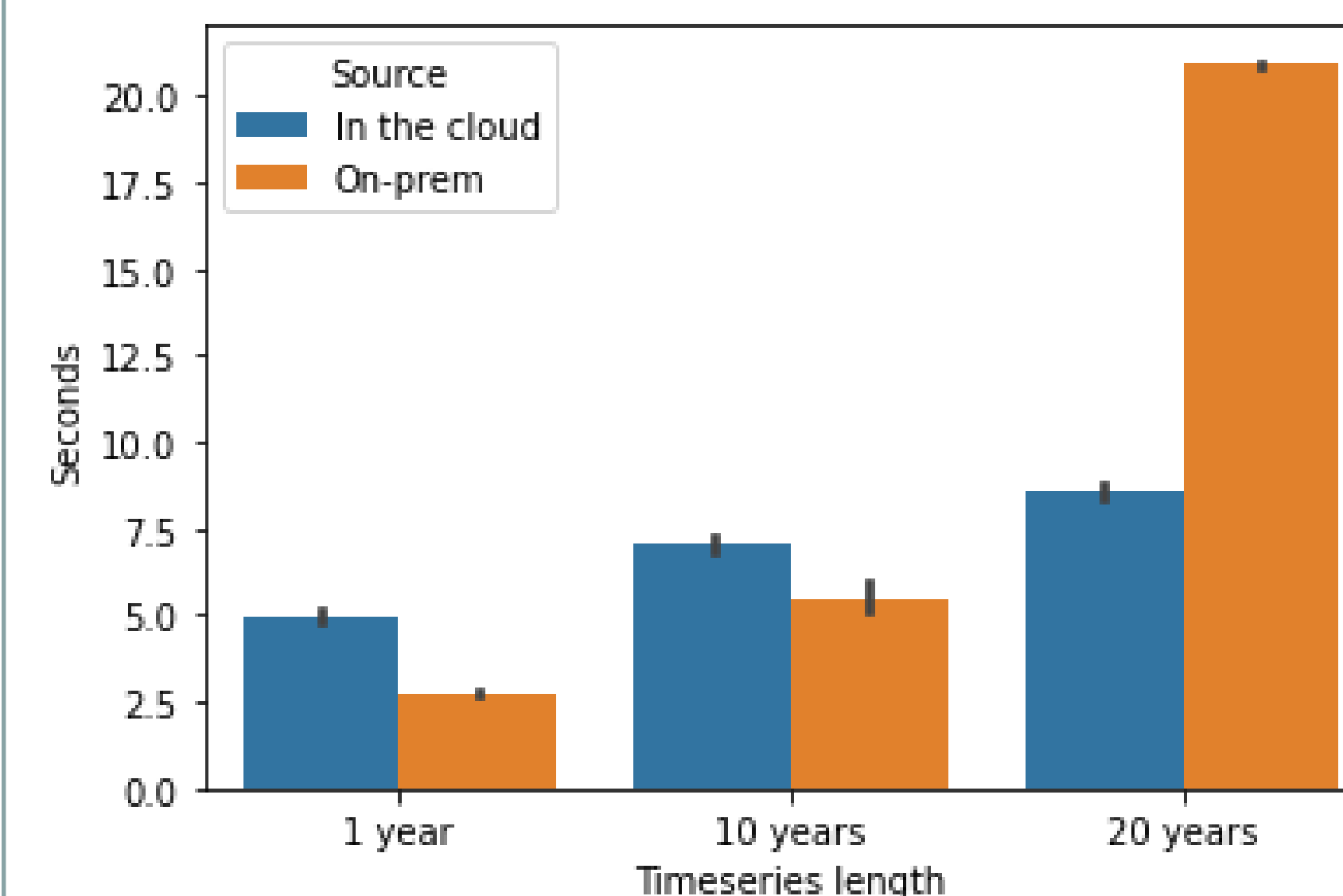
Benefits from data and services available in the cloud include:

- Improved Performance
- Multidisciplinary data access
- Analysis next to data

Data Access and Services

- ❖ **HTTPS:** Navigate by data product & date/time and download the data via HTTPS
- ❖ **EarthData Search:** Search for and retrieve data sets across multiple data centers
- ❖ **Subset:** Create variable and spatial subsets and download data in various data formats
- ❖ **OPeNDAP:** Search, subset, and download data via OPeNDAP
- ❖ **GDS:** Subset, analyze, and download data via GrADS Data Server (GDS)
- ❖ **Giovanni:** Web-based tool enabling users to interactively visualize and analyze data
- ❖ **Data Rods:** View and download long time series of a single data point
- ❖ **Direct S3 Access:** Access AWS cloud data from S3 storage using cloud native tools

Timeseries Service (Data Rods)



GLDAS Noah Land Surface Model L4 3-hourly 0.25 x 0.25 degree V2.1 data on-prem vs in the cloud timeseries retrieval speed comparison can be seen on the left.

- 1 year = 2920 timesteps
- 10 years = 29200 timesteps
- 20 years = 58400 timesteps

Timeseries access from the cloud is consistent for all ranges of timesteps. Accessing a longer timeseries from the cloud is faster than access from on-prem. A sample timeseries plot can be seen below.

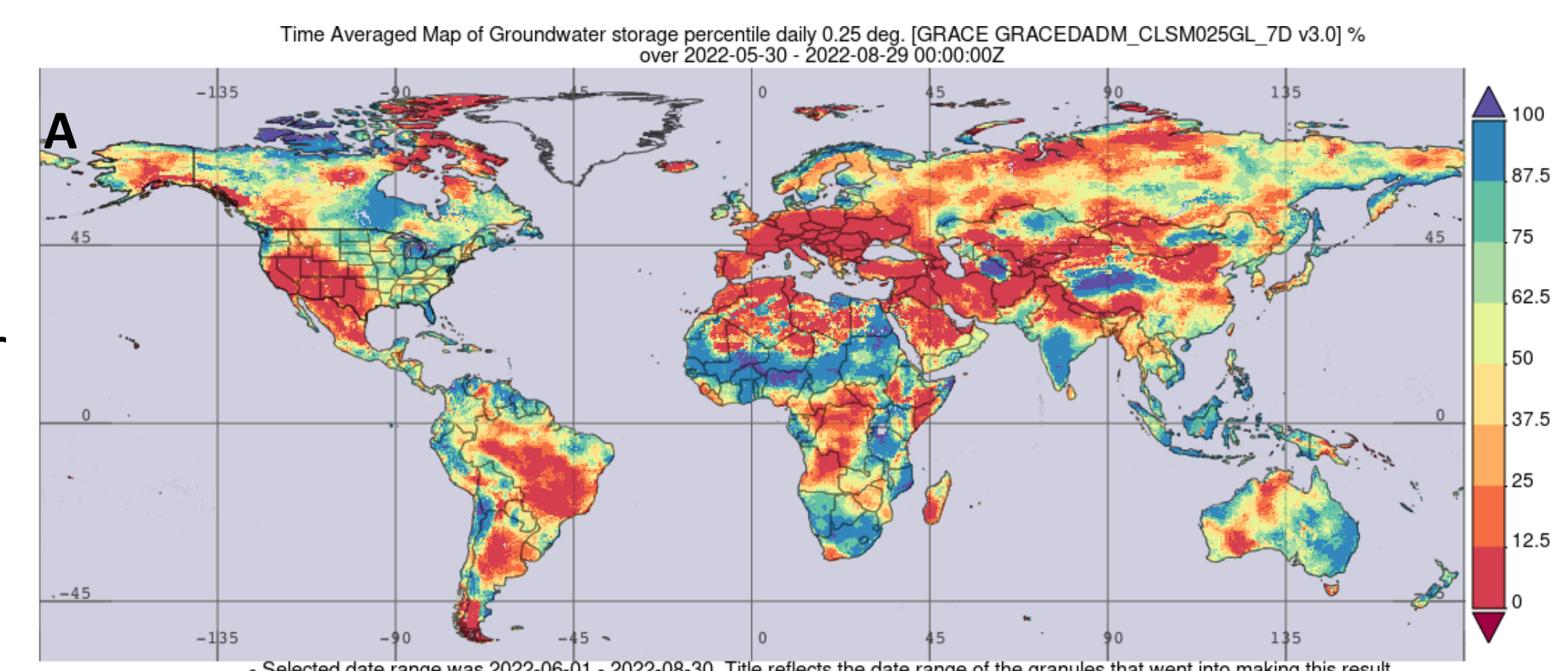


Hydrology Data Rods webpage

<https://disc.gsfc.nasa.gov/information/tools?title=Hydrology%20Data%20Rods>

Giovanni

Giovanni provides a simple way to visualize, analyze and access vast amounts of Earth science data without having to download the data. Figure A shows the average groundwater storage percentile for June, July, and August from Groundwater and Soil Moisture Conditions from GRACE and GRACE-FO Data Assimilation L4 7-days 0.25 x 0.25 degree Global V3.0 visualized using Giovanni.



Time Series, Area-Averaged of Anomaly of Surface air temperature monthly 0.1 deg. [FLDAS Model FLDAS_NOAH01_C_GL_MA v001] K over 1992-Jan - 2022-Sep-01 00:00:00Z, Shape Australia

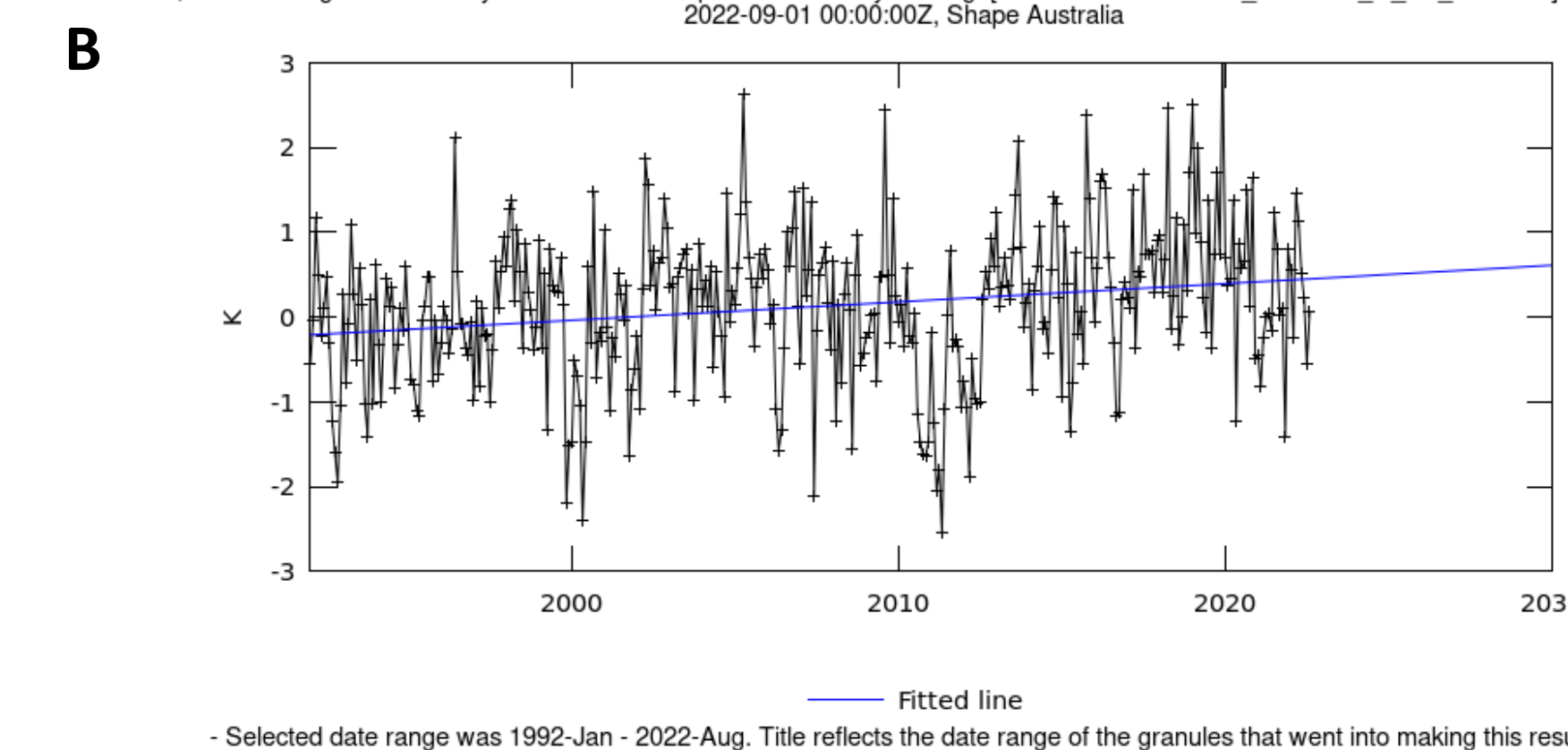


Figure B shows the increasing trend of Australia's surface air temperature monthly anomaly for the years 1992 to 2022 from FLDAS Noah Land Surface Model L4 Global Monthly Anomaly 0.1 x 0.1 degree (MERRA-2 and CHIRPS) visualized using the Area-Averaged Time Series function of Giovanni.